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## CHRONOLOGICAL STUDIES OF THE ARZHAN-2 SCYTHIAN MONUMENT IN TUVA (RUSSIA)

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**ABSTRACT.** The first radiocarbon dates from the unique early Scythian monument Arzhan-2, discovered in 2001, are presented. The monument contained a royal burial (grave nr 5). Unfortunately, precise dating is hampered by the Hallstatt plateau in the calibration curve. However, using both accelerator mass spectrometry measurements from buried materials and conventional dates for floating tree rings from the burial chamber, we were able to date the construction of the monument to the 7th century BC. This is consistent with archaeological expectations. Other graves located inside the barrow were also dated. Grave nr 11, located on the edge of the barrow, is younger, showing that the monument was a place of burial ritual for many years for this ancient population.

### INTRODUCTION

In 1970, the famous Arzhan-1 barrow was discovered in Tuva, Russia (Gryaznov 1980). This barrow is considered the earliest pre-Scythian or early Scythian monument in Eurasia, and it became the key monument for the study of all Eurasian Scythian cultures.

During 2001, a Russian-German research project discovered the Arzhan-2 monument in the Uyuk hollow, about 7 km from the Arzhan-1 barrow (Chugunov et al. 2001a–c; 2003). Arzhan-2 is unique because it has not been robbed or otherwise disturbed and appears untouched since its construction. The abundance and variety of well-preserved archaeological material in this monument has no equal among Eurasian Scythian monuments. Consequently, Arzhan-2 plays an important role in understanding the history of the Eurasian Scythian nomads. Concerning Scythian cultures, major questions concerning their origin, development, spread, and ways of life still need to be answered (Alekseev et al. 2001).

The Arzhan-2 barrow contains many graves. In 2001, grave nr 5 was discovered. Two skeletons dressed in richly decorated clothes, buried along with gold artifacts made in the typical Scythian animal style, show that this grave must have belonged to the upper levels of the nomadic nobility. Grave nr 5 is now known as the “royal grave” of Arzhan-2. The continuation of the excavation during the following season yielded further discoveries, and now we know that this monument contains more than 20 different graves. There are graves for women, children, and warriors, and a common horse grave with 14 skeletons. In addition, there were several graves made at later times. The chronology of the different graves and the period of construction and use of the monument itself needs to be established, using both archaeological and radiocarbon dating techniques.

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## RESULTS

### Wooden Logs: Conventional Dating

Arzhan-2 is located in the Uyük hollow of the Tuva Republic (52°05'N and 93°42'E). It contains organic material suitable for both accelerator mass spectrometry (AMS) and conventional  $^{14}\text{C}$  dating. First, we investigated the chronology of the royal grave, nr 5. The chamber of this grave consists of a wooden floor and 2 walls (external and internal) made from horizontally stacked logs. In 2001, before the reconstruction of the chamber, one of these logs (D3) containing 133 rings from the covering was used for both  $^{14}\text{C}$  dating and dendrochronological measurements. The results are shown in Table 1.

Table 1  $^{14}\text{C}$  dates of tree-ring samples for log D3.

Nr	Lab code	Tree rings (counted from the center)	$^{14}\text{C}$ age	Corrected $^{14}\text{C}$ age (BP)
1	Le-6260	0–20	$2635 \pm 60$	not used
2	Le-6261	21–30	$2444 \pm 50$	$2515 \pm 50$
3	Le-6262	31–40	$2421 \pm 24$	$2492 \pm 24$
4	Le-6263	41–50	$2359 \pm 18$	$2430 \pm 18$
5	Le-6264	51–60	$2390 \pm 18$	$2461 \pm 18$
6	Le-6265	61–70	$2400 \pm 18$	$2471 \pm 18$
7	Le-6266	71–80	$2391 \pm 18$	$2462 \pm 18$
8	Le-6267	81–90	$2420 \pm 18$	$2491 \pm 18$
9	Le-6268	91–100	$2327 \pm 18$	$2398 \pm 18$
10	Le-6269	101–127	$2437 \pm 21$	$2508 \pm 21$

The first chronology for the Arzhan-2 monument was obtained using wiggle-matching of these dates, showing that the construction dates to the calendar interval ( $2\sigma$ ) 670–625 cal BC (Chugunov et al. 2003). After the reconstruction of the chamber, logs from the walls could be used as well. We selected log C3 from the internal wall; log C3 contained 150 rings. The results for this log are shown in Table 2.

Table 2  $^{14}\text{C}$  dates of tree-ring samples for log C3.

Nr	Lab code	Tree rings	$^{14}\text{C}$ age	Corrected $^{14}\text{C}$ age (BP)
1	Le-6561	1–10	$2435 \pm 20$	$2518 \pm 20$
2	Le-6562	11–30	$2408 \pm 20$	$2505 \pm 20$
3	Le-6563	31–50	$2409 \pm 18$	$2475 \pm 18$
4	Le-6564	51–70	$2354 \pm 16$	$2462 \pm 16$
5	Le-6565	71–90	$2419 \pm 16$	$2485 \pm 16$
6	Le-6566	91–100	$2391 \pm 16$	$2506 \pm 16$
7	Le-6567	101–110	$2458 \pm 20$	$2503 \pm 20$
8	Le-6568	111–120	$2377 \pm 16$	$2488 \pm 16$
9	Le-6569	121–130	$2374 \pm 16$	$2473 \pm 16$
10	Le-6570	131–140	$2408 \pm 20$	$2471 \pm 20$
11	Le-6571	141–150	$2401 \pm 15$	$2495 \pm 15$

By comparing the dating results for the 2 logs (Tables 1 and 2), one can see that the  $^{14}\text{C}$  ages cover practically the same interval. However, the  $^{14}\text{C}$  dates fall on the large so-called Hallstatt plateau

(about 800–400 BC) of the calibration curve. This makes it difficult to calibrate the  $^{14}\text{C}$  dates to the calendar ages for this monument. The plateau follows a period with increased atmospheric  $\Delta^{14}\text{C}$  caused by solar activity changes (van Geel et al. 1998).

Logs D3 and C3 were subdivided into sections of 10–20 tree rings and were  $^{14}\text{C}$  dated at the Institute for the History of Material Culture, St Petersburg (lab code Le) using liquid scintillation spectrometry (Zaitseva et al. 1999).  $\delta^{13}\text{C}$  values were not measured; instead, a correction factor, taking into account systematic errors resulting from instrumental errors and isotopic fractionation effects, was determined. We used a method of low-frequency filtration to exclude the high-frequency noise (Der-gachev et al. 2001).  $^{14}\text{C}$  dates determined this way for logs C3 and D3 are shown in column 5 (Tables 1 and 2). These corrected  $^{14}\text{C}$  ages were used for the assessment of the concordance of the dates with the calibration curve using a statistical approach. The  $^{14}\text{C}$  dates are matched to the calibration curve by minimizing the statistical parameter  $\chi^2_{n-1}$ , where  $n$  is the number of the samples from the log. The results are shown in Figures 1 and 2.

As one can see from Figures 1 and 2, the felling dates for these logs show that the construction of grave nr 5 can be dated to the middle or end of the 7th century BC.

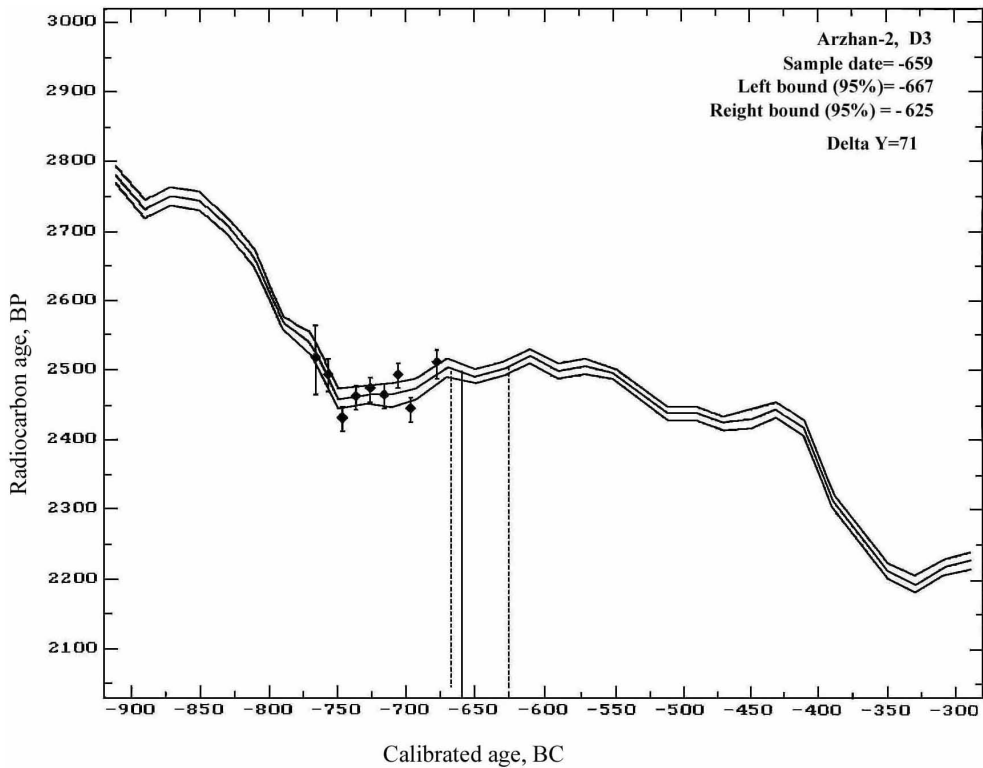


Figure 1 The position of the corrected  $^{14}\text{C}$  ages for log C3 from the inside wall of grave nr 5. The date of the felling of this log is 622 cal BC (solid line). The left limit of the 95% confidence interval is 642 cal BC; the right limit is 602 cal BC (vertical lines).

The most probable felling date for these logs is 659 BC, with 2- $\sigma$  confidence limits of 671–609 BC. We tried to estimate the reliability of this date mathematically; this approach is presented in Figures 3 and 4.

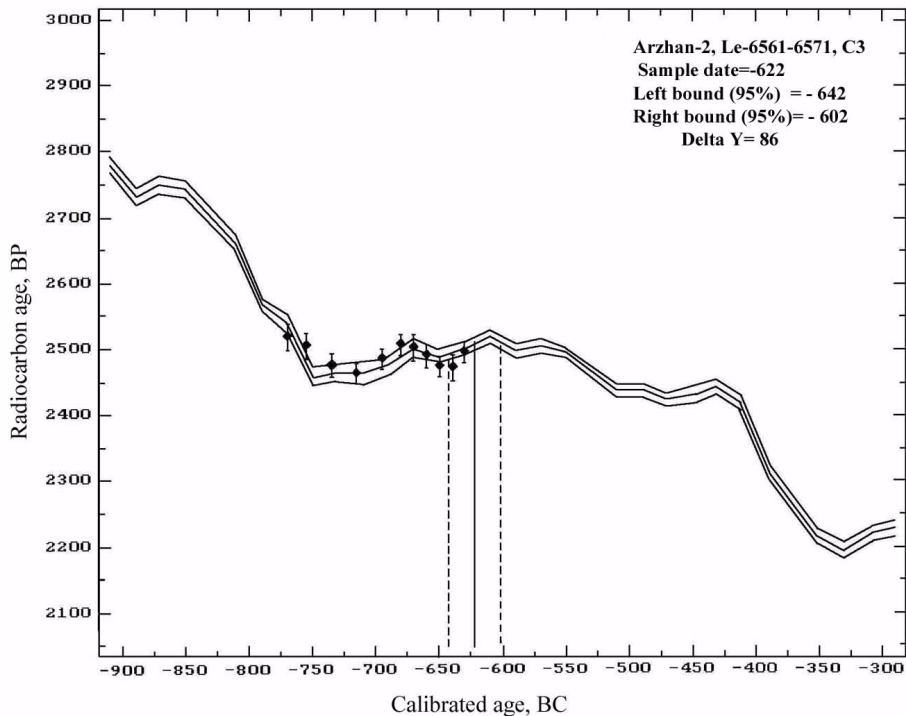


Figure 2 The position of the corrected  $^{14}\text{C}$  age for log D3 from the covering of grave nr 5. The date of the felling of this log is 660 cal BC (solid line). The left limit of the 95% confidence interval is 670 cal BC; the right limit is 610 cal BC (vertical lines).

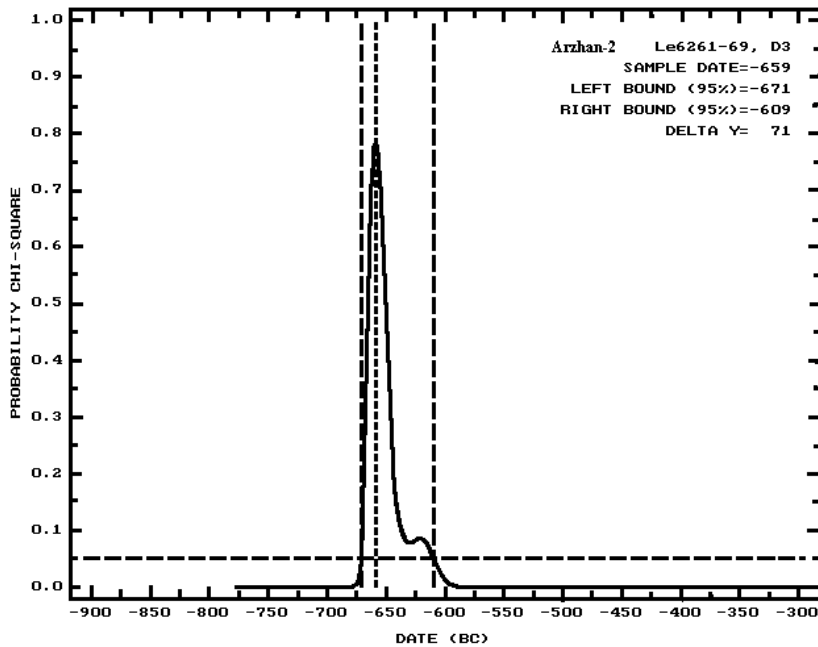


Figure 3 The reliability of the  $^{14}\text{C}$  dates for log C3. The dotted vertical line is the position of the most probable date. The dashed lines are the right and left confidence limits; the dashed horizontal line corresponds to a probability of 0.05. The most probable date for the felling of this log is 622 BC. The right and left confidence limits are 642 and 602 BC.

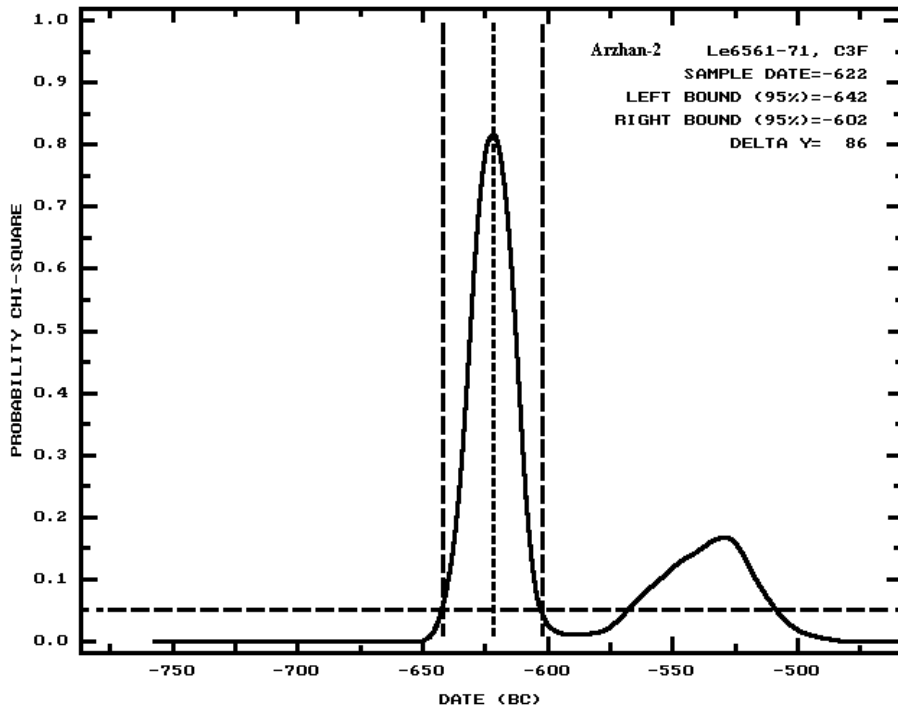


Figure 4 The reliability of the  $^{14}\text{C}$  dates for log D3. The most probable date of the felling of this log is 659 BC. The right and left confidence limits are 671 and 609 BC.

### AMS Results

In grave nr 5, many different organic materials were found and were AMS dated. Among them are the remains of clothing (textile, leather, felt), various seeds, bone, and wooden objects. The results of these AMS-dated finds are shown in Table 3.

Table 3 AMS  $^{14}\text{C}$  dates for the Arzhan-2 barrow, grave nr 5.

Nr	Lab code	$^{14}\text{C}$ age BP	Dated material
1	GrA-18910	$2520 \pm 40$	Grain
2	GrA-18920	$2540 \pm 45$	Textile
3	GrA-18931	$2465 \pm 40$	Grain
4	GrA-18932	$2565 \pm 40$	Leather
5	GrA-18935	$2470 \pm 40$	Wood
6	GrA-18938	$2535 \pm 45$	Soil
7	GrA-18939	$2455 \pm 45$	Textile, alkali fraction
8	GrA-18948	$2485 \pm 40$	Grain
9	GrA-18949	$2565 \pm 40$	Grain
10	GrA-18962	$2520 \pm 45$	Leather
11	Ua-18487	$2475 \pm 50$	Wood from branch
12	Ua-18488	$2350 \pm 50$	Small grains
13	Ua-18489	$2495 \pm 50$	Leather
14	AA-46872	$2533 \pm 39$	Wood from artifact
15	AA-46873	$2503 \pm 39$	Bark from bow
16	AA-46874	$2494 \pm 40$	Seeds
17	AA-46875	$2496 \pm 43$	Wood from artifact

All these  $^{14}\text{C}$  dates lie close to 2500 BP. The weighted mean  $^{14}\text{C}$  age calculated by the OxCal program (Bronk Ramsey 1994, 1998) is  $2501 \pm 10$  BP. Calibration for this combined age is shown in Figure 5.

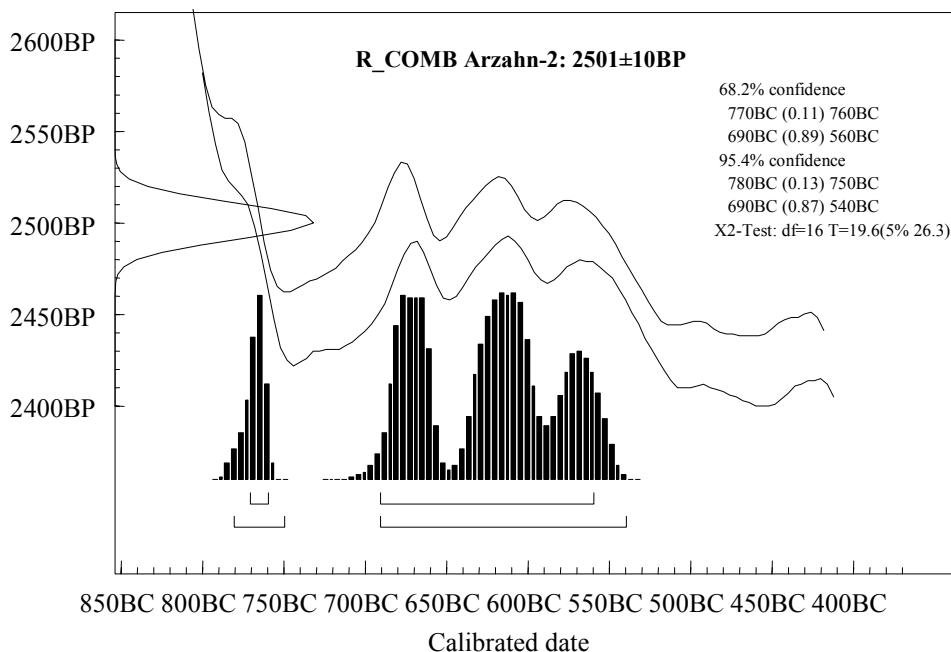


Figure 5 The combined  $^{14}\text{C}$  date from the 17  $^{14}\text{C}$  ages produced by AMS from different organic materials in grave nr 5 and their calibration.

The combined  $^{14}\text{C}$  date, albeit very precise, corresponds to a rather wide calendar interval: 780–540 cal BC ( $2\sigma$ ) and 770–560 cal BC ( $1\sigma$ ). Nevertheless, the AMS dates agree with the wiggle matching result from the wood (grave construction), indicating that grave nr 5 was constructed during the beginning-middle of the 7th century BC. This corresponds well with the archaeological perspective that Arzhan-2 dates from the 6th to the 7th centuries BC.

In 2002, additional graves were discovered in this monument; at present, more than 20 graves have been identified. Many of them are important but contain fewer gold artifacts. Graves nr 13a and 13b are stone burial mounds for females, separated by a stone wall. In the first chamber, 1 woman was buried and 2 women were buried in the other chamber. The clothing of the women is well preserved and of a very complicated design. It consists of several textile layers with different weaves, felt, fur, and other materials. The color of the different cloth layers can be seen.  $^{14}\text{C}$  dates were produced from the different organic components of the clothes by both AMS (Groningen, GrA) and conventional dating (St Petersburg, Le). The very unusual collective burial of horses (grave nr 16) was found inside the monument and contains 14 horse skeletons. Some artifacts made with similar ornamentation to those in the royal grave nr 5 were found in this grave. The horses' equipment and even the grass in their mouths was preserved. A variety of organic remains were used for  $^{14}\text{C}$  dating. Not far from the royal grave nr 5, a warrior burial (grave nr 20) with bronze artifacts and weapons was found. In stone-lined grave nr 26, male individuals were buried. Between the stone slabs covering the grave, charcoal was found, which was used for  $^{14}\text{C}$  dating. All these graves are located inside the barrow of Arzhan-2. In addition, there are graves inserted on the edge of the barrow. Grave nr 11 is such an inserted grave, made from stone slabs. Charcoal found between the slabs was used for  $^{14}\text{C}$  dating.  $^{14}\text{C}$  results from the different graves belonging to Arzhan-2 are shown in Table 4.

Table 4  $^{14}\text{C}$  dates of the different graves belonging to Arzhan-2.

Nr	Lab code	$^{14}\text{C}$ age (BP)	Grave nr	Dated material	cal BC interval (1 $\sigma$ )	cal BC interval (2 $\sigma$ )
1	GrA-21532	2240 $\pm$ 45	13a	Leather	390–240	400–200
2	GrA-21533	2555 $\pm$ 45	13a	Fur	810–550	820–520
3	GrA-21341	3010 $\pm$ 70	13b	Felt	1400–1160	1430–1040
4	GrA-21534	2330 $\pm$ 45	13b	Leather	510–370	550–200
5	Le-6338	2530 $\pm$ 70	13b	Fur	810–530	810–410
6	Le-6339	2410 $\pm$ 70	16	Wood	760–400	770–390
7	Le-6639	2320 $\pm$ 60	16	Bone, skeleton 17	520–250	800–200
8	GrA-21526	2100 $\pm$ 60	16	Grass, skeleton 4	200–40	360 BC–AD 20
9	GrA-21527	2500 $\pm$ 50	20	Destroyed leather near knife, skeleton 1	790–530	800–410
10	Le-6337	2385 $\pm$ 45	26	Charcoal	730–390	770–380
11	Le-6335	2290 $\pm$ 25	11	Charcoal	397–376	410–250

The  $^{14}\text{C}$  for different materials from the same grave are scattered, which is difficult to explain. It appears that the monument had been used during an extended period of time. The results will be discussed in more detail in the next section.

## DISCUSSION

Chronological research is essential for historical reconstructions. Key monuments form the basis of chronological correlations. Such a key monument is Arzhan-1, which is the earliest Scythian monument in Eurasia and dates to the 10th–9th century BC (Marsadolov et al. 1994; Zaitseva et al. 1998; Alekseev 2003). The latest period of the Scythian time cultures is represented by the key monuments of Pazyryk in the Altai, dating to the 3rd–4th century BC (Alekseev et al. 2001, 2003). It is noteworthy that there are only a few Scythian monuments which can be dated to the 7th–6th century BC.

The significance of Arzhan-2, discussed in this paper, is difficult to overestimate. Monuments in which all materials are preserved, reflecting practically all aspects of the way of life of the ancient population, are unique. In Arzhan-2, all the graves located inside the monument have not been disturbed, so that the objects found in this monument shed light on past life, ancient clothing, ritual traditions, and the relationship between nobility and other levels of the population. Therefore, the chronology of this unique monument is very important for all Eurasian Scythian history.

Most material from the royal grave nr 5 in Arzhan-2 corresponds to the early Scythian tradition, but sometimes it is rather difficult to find an analogy with materials and techniques from other known Scythian monuments. From an archaeological perspective, the Arzhan-2 monument can be dated to the 6th–7th century BC. In spite of the  $^{14}\text{C}$  dates produced from the logs of the different elements of the burial chamber, considerable difficulties remain in determining the calendar date of this burial due to the large plateau on the calibration curve. Various organic materials from this grave have also been dated by AMS. The average AMS  $^{14}\text{C}$  date and the date for the wiggle-matched wood indicate that the construction of grave nr 5 took place during the 7th century BC, which corresponds well with archaeological evidence.

The other graves inside the Arzhan-2 barrow play an important role too, because they provide material from other levels of the ancient population. The clothes in the women's graves (nr 13a and 13b) have a very complex design with many layers of different textiles, fur, and felt. The  $^{14}\text{C}$  dates from the textile and fur show that these graves are contemporaneous with the royal grave nr 5. Organic materials



from warrior grave nr 20, where a weapon assemblage was found, date from the same time. For the collective horse burial (grave nr 16), unfortunately, we are not yet able to present a definite date.

One of the inserted graves (nr 11) contained charcoal. The  $^{14}\text{C}$  date measured indicates that this grave was constructed later than the main barrow construction. Therefore, we conclude that the monument has been a ritual site for the ancient nomads, used for more than 100 yr.

Only 2 yr have passed since the discovery of this already famous Arzhan-2 monument. We present here the first results, and will continue its chronological study in the near future. We expect that, as the complete series of  $^{14}\text{C}$  and dendrochronological dates from other logs of the chamber construction are measured by different  $^{14}\text{C}$  laboratories, and as  $^{14}\text{C}$  dates are measured for other graves in this monument, we will be able to determine the age of this unique monument with more precision.

## CONCLUSION

The first  $^{14}\text{C}$  dates measured for a number of graves from the Arzhan-2 monument show that the time of construction dates back to the 7th century BC. A later date for an inserted grave indicates that this monument has been used as a place of ritual for the nomads over a long period of time, without the destruction of the main barrow.

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